BRANSON TECHNICAL INFORMATION PW-1

ULTRASONIC AND VIBRATION WELDING CHARACTERISTICS AND COMPATIBILITY OF THERMOPLASTICS

Most commonly used injection-molded polymers can be ultrasonically or vibration welded without the use of solvents, heat or adhesives. Ultrasonic weldability of these polymers depends on their melting temperature, modulus of elasticity, impact resistance, coefficient of friction, and thermal conductivity. Generally, the more rigid the plastic, the easier it is to weld. Low modulus polymers such as polyethylene and polypropylene can often be welded provided the horn can be positioned close to the joint area. Vibration welding is not as dependent upon resin characteristics to achieve a weld.

In staking, the opposite is usually true. The softer the plastic, the easier it is to stake. However, good results can be achieved with most plastics when the right amplitude and force combination is used.

Table 1, below, indicates relative weldability characteristics for the more common thermoplastics. Table II shows the compatibility for welding of dissimilar thermoplastics.

TABLE 1 CHARACTERISTICS**

	ULTRASONIC WELDING					
	Ease of Welding*					
Material	Near Field†	Far Field†	Swaging and Staking	Inserting	Spot Welding	VIBRATION WELDING
Amorphous Resins						
ABS	E	G	E	E	E	E
ABS/Polvcarbonate alloy (Cycoloy 800)	E-G	G	G	E-G	G	E
Acrylic[a]	G	G-F	F	G	G	E
Acrylic multipolymer (XT-polymer)	G	F	G	G	G	E
Butadiene-styrene (K-Resin)	G	F	G	G	G	G
Cellulosics — CA, CAB, CAP	F-P	P	G	E	F-P	E
Phenylene-oxide based resins (Noryl)	G	G	G-E	E	G	E-F
Polyamide-imide (Torlon)	G	F				G
Polycarbonate[b]	G	G	G-F	G	G	E
Polystyrene (general) purpose)	E	E	F	G-E	F	E
Rubber modified (high-impact)	G	G-F	E	E	E	E
Polysulfone[b]	G	F	G-F	G	F	E
PVC (rigid)	F-P	P	G	E	G-F	G
SAN-NAS-ASA	E	E	F	G	G-F	E
Crystalline Resins [c]						
Acetal	G	F	G-F	G	F	E
Fluoropolymers	P					F
Nylon [b]	G	F	G-F	G	F	E
Polyester (thermoplastic)	G	F	F	G	F	E
Polyethylene	F-P	P	G-F	G	G	G-F
Polymethylpentene (TPX)	F	F-P	G-F	E	G	E
Polyphenylene sulfide	G	F	P	G	F	G
Polypropylene	F	P	E	G	E	E

Code: E = Excellent, G = Good, F = Fair, P = Poor

*Ease of welding is a function of joint design, energy requirements, amplitude, and fixturing.

†Near field welding refers to joint ¼ in. (6.35 mm) or less from area of horn contact; far field welding to joint more than ¼ in. (6.35 mm) from contact area.

[a]Cast grades are more difficult to weld due to high molecular weight.

[b]Moisture will inhibit welds.

[c]Crystalline resins in general require higher amplitudes and higher energy levels because of higher melt temperatures and heat of fusion.

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TABLE II COMPATIBILITY OF THERMOPLASTICS**

	ABS	ABS/polycarbonate alloy (Cycoloy 800)	Acetal	Acrylic	Acrylic multipolymer	Butadiene-styrene	Cellulosics (CA, CAB, CAP)	Fluoropolymers	Nylon	Phenylene-oxide based resins (Noryl)	Polyamide-imide (Torlon)	Polycarbonate	Thermoplastic Polyester	Polyethylene	Polymethylpentene	Polyphenylene sulfide	Polypropylene	Polystyrene	Polysulfone	PVC	SAN-NAS-ASA
ABS	■	■		■	○															○	○
ABS/polycarbonate alloy (Cycoloy 800)	■	■		○								■									
Acetal			■																		
Acrylic	■	○		■	○					○		○									○
Acrylic multipolymer	○			○	■													○			○
Butadiene-styrene						■												○			
Cellulosics (CA, CAB, CAP)							■														
Fluoropolymers								■													
Nylon									■												
Phenylene-oxide based resins (Noryl)				○						■		○						■			○
Polyamide-imide (Torlon)											■										
Polycarbonate		■		○						○		■							○		
Thermoplastic Polyester													■								
Polyethylene														■							
Polymethylpentene															■						
Polyphenylene sulfide																■					
Polypropylene																	■				
Polystyrene					○	○				■								■			○
Polysulfone												○							■		
PVC	○																			■	
SAN-NAS-ASA	○			○	○					○								○			■

■ — Denotes compatibility

○ — Denotes compatibility in some cases

** — Tables should be used as a guide only, since variations in resins may produce slightly different results.

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JOINT DESIGN FOR ULTRASONIC WELDING

The diagrams in **Figure 1** show time-temperature curves for a common butt joint and the more ideal joint incorporating an energy director which permits rapid welding while achieving maximum strength. The material within the director flows throughout the joint area as indicated.

Figure 2 shows a simple butt joint modified with energy director showing desired proportions before weld and indicating the resultant flow of material. Parts should be dimensioned to allow for the dissipation of the material from the energy director throughout the joint area as illustrated. Practical considerations suggest a minimum height of 0.010" (0.25 mm) for the energy director for easy-to-weld resins. Larger energy directors may be necessary for certain high-energy-requiring resins, i.e. crystalline, low stiffness, or high melt temperature amorphous (e.g. polycarbonate, polysulfone) resins; minimum height of 0.020" (0.5 mm) is generally preferred. Means for alignment between the parts, such as a pin and socket, should be included in the part design.

It should be noted that joints designed for solvent sealing can generally be modified to meet ultrasonic welding requirements.

TO BE AVOIDED - A typical mistake with energy director design is beveling one joint face at 45° angles. **Figure 3** shows the result if this practice is followed.

Figure 4 illustrates a step joint used for alignment and for applications where excess melt, or flash, on the side would be objectionable.

A tongue and groove joint (**Figure 5**) is used primarily for scan welding and prevention of flash both internally and externally. The need to maintain clearance on both sides of the tongue, however, makes this more difficult to mold. Draft angles can be modified concurrently with good molding practices, but interference between elements must be avoided.

Figure 1

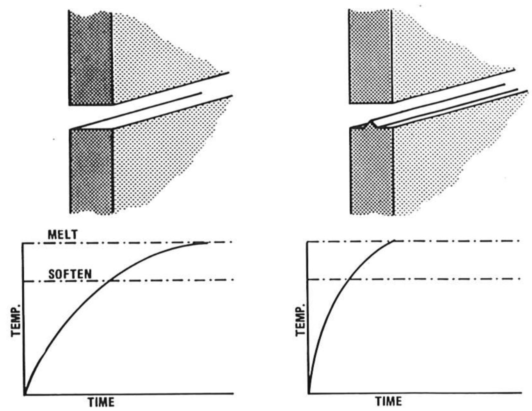

Figure 2

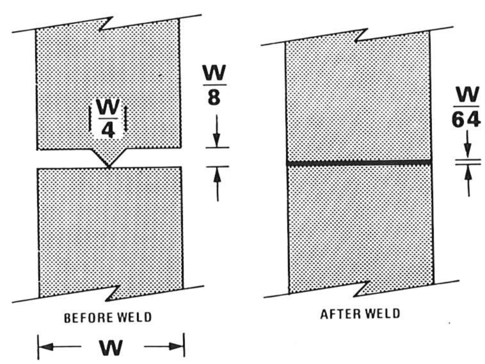

Figure 3

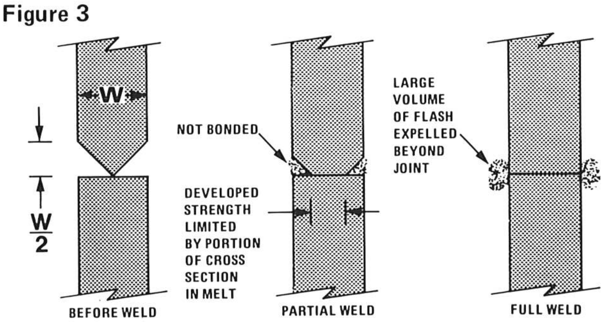

Figure 4

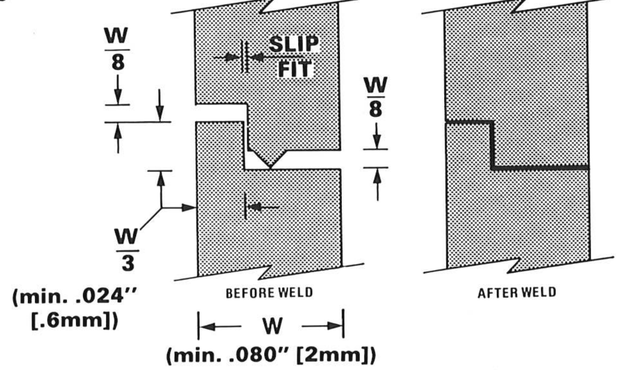

Figure 5

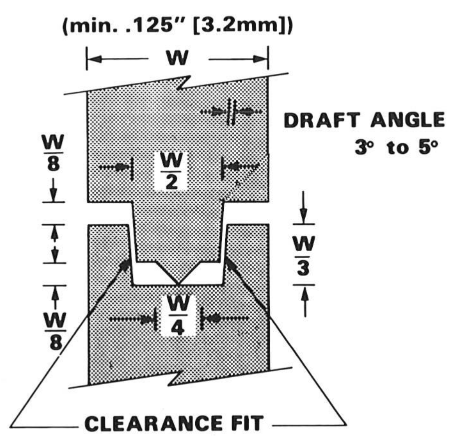

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Figure 6 illustrates basic energy director joint variations suitable for ultrasonic welding. These are suggested guidelines for typical joint proportions. Specific applications may require a slight modification.

Figure 7 shows the shear joint used when a strong hermetic seal is needed, especially for the crystalline resins (nylon, acetal, thermoplastic polyester, polyethylene, polypropylene, and polyphenylene sulfide). Since crystalline resins change rapidly from a solid to a molten state over a narrow temperature range, an energy director type of joint may not be the optimum because the molten resin from the director will rapidly solidify before it is able to fuse with the adjoining surfaces. With the shear joint, welding is accomplished by first melting the small, initial contact area and then continuing to melt with a controlled interference along the vertical walls as the parts telescope together. A lead-in is required for self locating, and a flash trap can be incorporated if necessary.

The strength of the joint is a function of the vertical dimension of the joint (depth of weld) and can be adjusted to meet the requirements of the application. For joint strength exceeding the part strength, a depth of 1.25x wall thickness is suggested.

Typical interference for the joint is given in the table below:

Maximum Part Dimension	Interference per Side (Range)	Part Dimension Tolerance
Less than 0.75″ (18mm)	0.008″ to 0.012″ (0.2 to 0.3mm)	±0.001″ (±0.025mm)
0.75″ to 1.50″ (18mm-35mm)	0.012″ to 0.016″ (0.3 to 0.4mm)	±0.002″ (±0.05mm)
Greater than 1.50″ (35mm)	0.016″ to 0.020″ (0.4 to 0.5mm)	±0.003″ (±0.075mm)

The walls of the bottom section must be supported at the joint by the holding fixture, which conforms closely to the outside configuration of the part, to avoid outward deflection under welding pressure. The top part should be as shallow as possible, in effect just a lid to avoid inward deflection. For a midwall joint, the tongue and groove variation in **Figure 8** is preferred. It is also useful for large parts. **Figure 9** shows variations of the basic shear joint design.

Figure 9

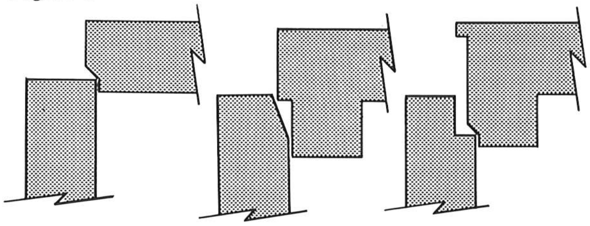


Figure 6

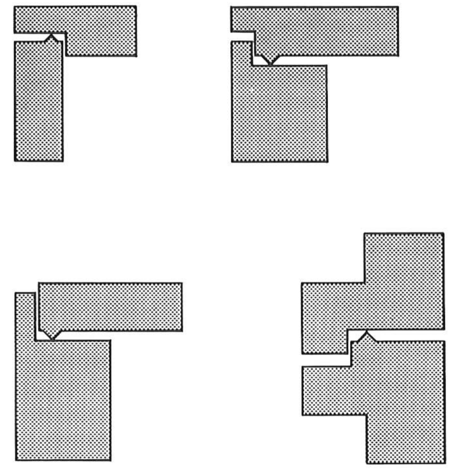


Figure 7

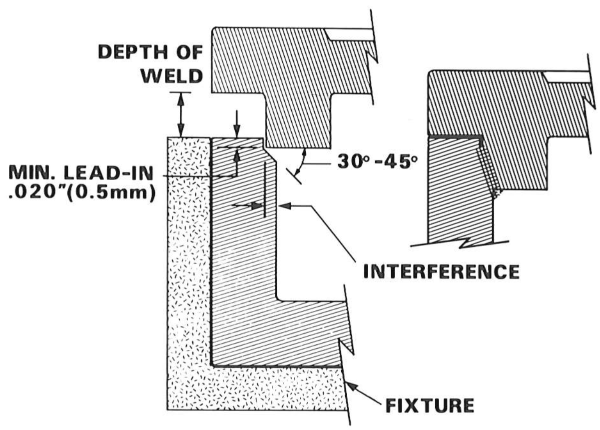
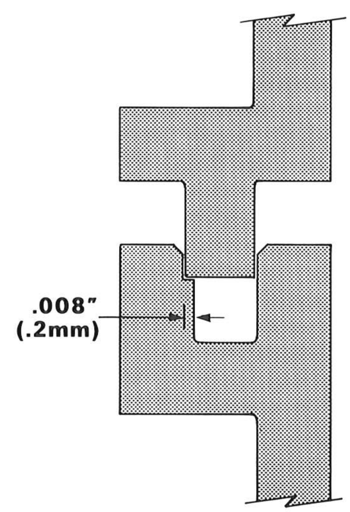


Figure 8



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ULTRASONIC STAKING

Ultrasonic staking is an assembly method that uses the controlled melting and reforming of a plastic stud or boss to capture or lock another component of an assembly in place. The plastic stud protrudes through a hole in the component to be locked in place. High frequency vibrations of the ultrasonic horn are imparted to the top of the stud, which melts and fills the volume of the horn cavity to produce a head, locking the component in place. The progressive melting of plastic under continuous but generally light pressure forms the head.

The advantages of ultrasonic staking include short cycle time (generally less than one second), tight assemblies with virtually no tendency for recovery, the ability to perform multiple stakes with one horn, repeatability and control over the process, design simplicity, and the elimination of consumables such as screws.

STAKING CONFIGURATIONS

The integrity of an ultrasonically staked assembly depends upon the volumetric relationship between the stud and horn cavity **(see Figure 1)** and the ultrasonic parameters used when forming the stud (e.g., amplitude of the horn, weld time, pressure). Proper stake design produces optimum strength and appearance with minimum flash.

Several configurations for stud/cavity design are available. The requirements of the application and physical size of the stud(s) being staked determine the design to be utilized. The principle of staking is the same for each: the area of initial contact between the horn and stud should be kept to a minimum, thus concentrating the energy to produce a rapid melt.

Standard Profile Stake

The standard profile stake **(Figure 2)** is most commonly used for studs having a diameter between 1/16 and 3/16 inch (1.6 – 4.8 mm). The top of the stud is flat, and melt is initiated by the point in the horn cavity. The head produced is twice the diameter of the stud and satisfies the requirements of the majority of staking applications. It is ideal for staking non-abrasive thermoplastics, both rigid and non-rigid. Standard horn tips are available for studs with diameters of 1/32 to 3/16 inch.

Dome Stake

The dome stake **(Figure 3)** is recommended for studs with a diameter of 1/16 inch or less. The top of the stud should be tapered (cone-shaped), the point of which initiates material melt reducing energy being transmitted through the stud. Alignment between the horn and the stud is not as critical as with the standard profile, and the appearance of the staked head is neat. The dome staking tip is less susceptible to wear than the standard profile tip when abrasive materials are being staked.

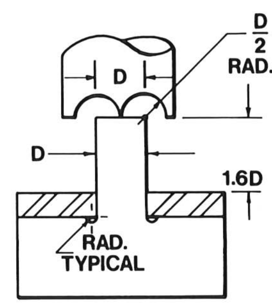


Figure 1

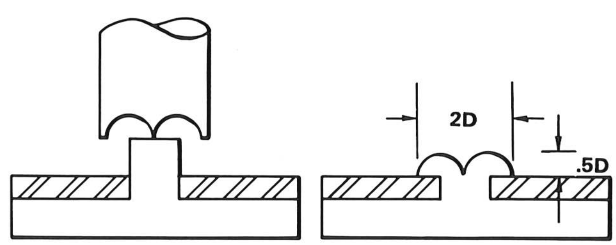


Figure 2

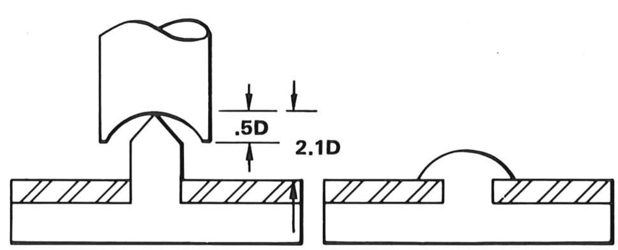


Figure 3

Knurled Stake

The knurled stake **(Figure 4)**, available in both male and female patterns, is designed for simplicity and rapid rate of assembly, and is used when appearance and strength are not critical. There is no dimensioned horn cavity, and multiple stakes may be made without concern for precise horn alignment or stud diameter. A hand-held welding gun may be utilized.

Flush Stake

For applications requiring a flush surface and having sufficient thickness in the contained piece for a recess, the flush stake **(Figure 5)** is ideal. The tapered stud design used for dome staking is recommended, and a flat-faced horn or tip is utilized. Flush staking may be used for all thermoplastics.

Hollow Stake

The hollow stake **(Figure 6)** is generally used when studs are greater than 3/16 inch (4.8 mm) in diameter. Hollow studs offer advantages in molding, because they prevent surface sinks and internal voids. Staking a hollow stud produces a large, strong head without having to melt a large amount of material. Also, where disassembly for repair is a primary requirement of the application, repairs can be made by breaking away the formed stud head for access and driving a self-tapping screw into the inside diameter of the stud for reassembly.

MULTIPLE STAKING

More than one stud may be staked in a single operation. The horn used for multiple staking can be half- or full-wavelength in design. If the studs are on the same plane and within 1/2 inch (12.7 mm) of each other, a half-wave horn is recommended. Large parts having studs widely spaced on the same plane would require a full-wave composite horn to provide the necessary amplitude for staking.

STAKING TECHNIQUES

In ultrasonic staking, the most common setup parameters involve contacting the stud using high amplitude and low pressure and allowing the molten material to flow into the horn cavity. Some high melt temperature thermoplastics, especially crystalline resins, tend to form a weak, brittle head. In these cases, using the standard profile staking tip, high pressure, high amplitude, and high trigger pressure may give best results.

Another approach to obtaining higher strength when staking crystalline resins uses the combination of high pressure, low amplitude, and high trigger pressure. A flat-surfaced stud is contacted with a flat-faced horn. The material yields under high pressure and heat generated by the ultrasonic vibrations, and mushrooms just below the top of the stud with no flash and no recovery.

The stud should be properly located and rigidly supported from below to ensure that it is correctly aligned with the horn cavity and that energy will be expended at the horn/stud interface rather than exciting the entire plastic assembly and fixture.

The ultrasonic horn should descend upon the stud with a moderately slow stroke speed, allowing time for the melt to occur and preventing the stud from being misformed by pressure.

Best staking results are obtained when ultrasonic vibrations are started using either light trigger pressure or a pretrigger switch prior to contacting the stud. This prevents "cold forming" or buckling of the stud.

STAKING CHARACTERISTICS OF THERMOPLASTIC RESINS

For the staking characteristics of the various materials, refer to Technical Information Sheet PW-1.

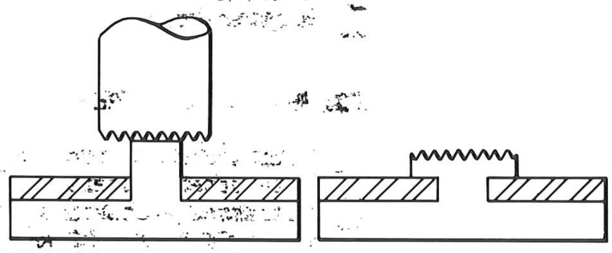


Figure 4

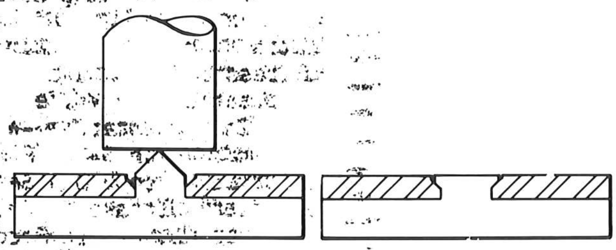
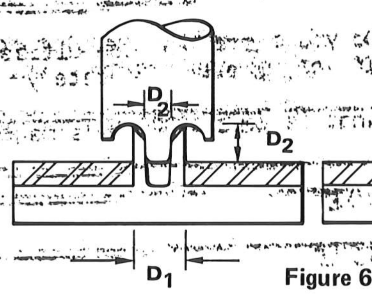


Figure 5



$D_2 = \frac{D_1}{2}$

Figure 6

BRANSON TECHNICAL INFORMATION PW-7

ULTRASONIC WELDING CHARACTERISTICS OF TEXTILES AND FILMS

The textiles and films most suited to ultrasonic welding are thermoplastic materials with similar melt temperatures and like molecular structure.

Materials most suited for ultrasonic processing have many of the following characteristics:

- Broad melting range
- High coefficient of friction
- No less than 65% thermoplastic content
- Uniform thickness
- Sufficient rigidity and thickness to accept energy at the material interface (at least 0.0005" thick.)

Table 1 indicates relative weldability characteristics for the more common textiles and films.

MATERIAL CONSTRUCTION AND FACTORS INFLUENCING WELDABILITY OF TEXTILES AND FILMS

WOVENS — Textiles formed by the regular interweaving of filaments or yarns in two directions perpendicular to one another.

Factors Influencing Weldability: Thread density, tightness of weave, uniformity of material thickness. Weld strength may vary due to the perpendicular orientation of yarns or filaments.

KNITS — Textiles formed by interconnecting continuous loops of filaments or yarns.

Factors Influencing Weldability: Style of knit and elasticity of material. (Elasticity of knits may affect "trueness" of weld in continuous processing, resulting in a "scalloped effect.")

NONWOVENS — Textiles formed by bonding and/or interlocking fibers, yarns or filaments by mechanical, thermal or solvent means.

Factors Influencing Weldability: Uniformity of material thickness. Random orientation of fibers gives nonwovens excellent strength.

FILMS — Thermoplastic material that has been cast, extruded or blown into a film, generally under 0.01" thick (0.254 mm).

Factors Influencing Weldability: Film thickness and density.

COATED MATERIALS — Textiles and films covered with a layer of thermoplastic, such as polyethylene, polypropylene or urethane. Base material need not be thermoplastic (i.e. coated cardboard.)

Factors Influencing Weldability: Coating material and thickness.

LAMINATES — Textiles and films consisting of two or more dissimilar layers in a "sandwich" form.

Factors Influencing Weldability: The mating surface should have a lower melt temperature than the other laminate layers.

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CHARACTERISTICS

EASE OF WELDABILITY

Table 1

Material	Characteristics	Uses	Woven	Nonwoven	Knitted	Coated Materials	Laminates	Film
Polyester	Resistant to most organic solvents & chemicals, strong, abrasion resistant	Sheets, filters, clothing, quilts, disposable garments, packaging materials, recording tapes, mattress pads, conveyor belts, sails, fibrefill, laminates	G	E	G	E	E	E
Nylon	Resistant to most organic chemical solvents, strong, abrasion resistant, elastic	Hook & loop material, carpet, lingerie, filters, cooking bags, meat bags, rainwear, camping gear, seat belts	E-G	E-G	G	G	G	G
Polypropylene	Good chemical resistance and wicking characteristics	Carpet backing, bagging, upholstery, tents, outdoor furniture, snack food packaging	G	E	G	G	G	G
Polyethylene	Tough, flexible, inexpensive, high density polyethylene welds best	Packaging films, laminates, disposable clothing		E		G	G-P	F-P
PVC	Resistant to water and many chemicals, good insulating characteristics; NOTE: the addition of plasticizers to impart flexibility in the material inhibits weldability	Films, shrink packaging, tarps, outdoor furniture	G-P			G-P	G-P	G-P
Acrylic	Unaffected by most detergent solutions, inorganic acids and alkalines. Attacked by aromatic hydrocarbons, esters, and keytones.	Knitting yarns, filters, awnings, blankets, sportswear	F-P	F-P	F-P	F-P		F-P
Urethane	Thermoplastic urethane is weldable.	Rainwear, sponges, filters		G		E-G		

E = Excellent
G = Good
F = Fair
P = Poor

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BRANSON DATA SHEET PW-18

150 WATT
ULTRASONIC POWER SUPPLY
MODEL E-150B

GENERAL DESCRIPTION

The Branson Model E-150B is a rugged solid-state 20kHz ultrasonic power supply designed for use with the Model HG-152 Hand Held Spot Welder, extending the scope of ultrasonic assembly to areas inaccessible to conventional plastic welders. Such applications include assembly of large parts, and parts with hard-to-reach joining surfaces.

KEY FEATURES

- **Automatic Frequency Control** eliminates the need for adjustment of the power supply after initial setup.
- **Automatic Amplitude Compensation** provides constant horn amplitude for the different energy requirements encountered during the operating cycle.
- **Front Panel Loading Meter** indicates the level of ultrasonic energy absorbed by the load.
- **Amplitude Control** enables the amplitude to be varied from 50% to 100%.
- **Weld Time Control** sets the duration of ultrasonic energy delivered to the horn (variable from 0.1 to 6.0 seconds). (Hold time fixed at 0.3 second.)
- **Converter Compatibility** — The Model E-150B Power Supply is compatible with Branson Converters Models TW-1 (0.003" amplitude), TW-2 (0.005" amplitude), and TW-3 (0.0013" amplitude). (Note: TW converters have a 50% maximum duty cycle.)

WARRANTY

The Branson Model E-150B Ultrasonic Power Supply carries a one-year warranty on all parts.

ELECTRICAL SPECIFICATIONS

Power requirements:

117V model		
Line voltage:	117V, 1Ø	
Line fuse:	4 Amp	
Line current:	2.2 Amp	
100V model		
Line voltage:	100V, 1Ø	
Line fuse:	4 Amp	
Line current:	2.6 Amp	
200/245V model		
Line voltage:	200V, 1Ø	230V, 1Ø
Line fuse:	4 Amp	4 Amp
Line current:	1.4 Amp	1.2 Amp

Output power:
150 electrical watts to converter
135 mechanical watts to load

The Branson Model E-150B Ultrasonic Power Supply complies with FCC and VDE rules and regulations governing radio frequency interference.

Supersedes PW-18, 4/82

Printed in U.S.A. 3/86

MECHANICAL SPECIFICATIONS

Weight:	
117V model:	15 lbs. (7 kg)
100,200/245V models:	20 lbs. (9 kg)

Note: All specifications subject to change without notice.

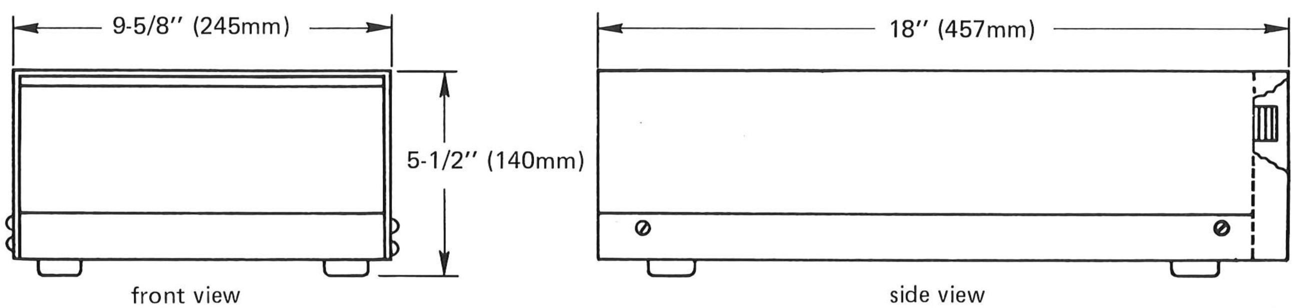
ORDERING INFORMATION

	Branson EDP#
Power Supply Model E-150B 117V model	101-132-096
100, 200/245V models (export only)	101-132-095

ACCESSORIES

	Branson EDP#
Cable, J48S (E-150B to customer's actuator) (8′)	100-146-989
RF Cable, J41S (E-150B to TW-1 or TW-2) (8′)	100-146-557
PB6 Palm Buttons	100-146-415
Start Cable, J33 (8′)	100-146-412
External Trigger Cable, J27S (E-150B to customer's device) (8′)	100-146-559
TW-1 Converter (0.003″ amplitude [75 microns])	101-135-015
TW-2 Converter (0.005″ amplitude [125 microns])	101-135-016
TW-3 Converter (0.0013″ amplitude [33 microns])	101-135-031
Hand-held Spot Welder HG-152 with TW-1 Converter*	101-063-093
Hand-held Spot Welder HG-152 with TW-2 Converter*	101-063-095

*See Data Sheet PW-19 for more information.



Note: Dimensions are approximate.

Note: The Model E-150B ultrasonic power supply is not suitable for applications requiring metal-to-metal contact, e.g., ultrasonic insertion or slitting.

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BRANSON DATA SHEET PW-19

HAND-HELD ULTRASONIC SPOT WELDERS
MODEL GK-5
MODEL HG-152

GENERAL DESCRIPTION

The GK-5 and HG-152 hand-held spot welders are compact, lightweight tools for the ultrasonic assembly of large parts and those with hard to reach joint areas.

With the GK-5, pressure is controlled manually, and a trigger switch located in the grip permits the operator to control the duration of applied ultrasonic energy.

On the HG-152, the operator grips a sliding, spring-loaded sleeve, and by applying pressure against the parts to be welded, triggers the ultrasonic welding cycle. Welding duration is controlled by the power supply. Automatic switching energizes the power supply whenever the unit is pressed against the joining surfaces of the workpiece; by lifting the unit away from the workpiece, the switch will override the weld time setting, causing the power supply to de-energize. Adjustment of a screw will vary the pressure required before ultrasonic triggering occurs. A metal hang-up ring allows suspension of the unit overhead during production line operation.

Model HG-152 Ultrasonic Spot Welder

Model GK-5 Ultrasonic Spot Welder
with Model 182V Power Supply

KEY FEATURES

- **Simple Design** enables operators to be trained in minutes to perform high-volume, high-integrity welding.
- **Power Supply Compatibility** — The Model HG-152 spot welder operates with the Model E-150B, 150-watt power supply (see Data Sheet PW-18). The Model GK-5 spot welder is compatible with power supply Models 182V, 450 watts, and 184V, 900 watts (see Data Sheet PW-25).
- **Standard Threaded Tips** available for spot welding and staking.

WARRANTY

The Branson Models GK-5 and HG-152 Ultrasonic Spot Welders are designed for durable, trouble-free performance. All parts are warranted for one year.

Supersedes PW-19, 8/83

Printed in U.S.A. 6/86

ELECTRICAL SPECIFICATIONS

Satisfied by power supply

MECHANICAL SPECIFICATIONS

Dimensions:

Model HG-152:

Grip diameter:	2" (50.8 mm)
Length:	10" (254 mm)
Weight:	2.2 lbs. (1 kg)
Cable length:	8' (2.4 m)

Model GK-5:

Body diameter:	3.25" (82.5 mm)
Length:	9.5" (241.3 mm)
Weight:	3.3 lbs. (1.5 kg)
Cable length:	12' (3.7 m)

ORDERING INFORMATION

	Branson EDP#
Model HG-152	
HG-152 Spot Welder with 8' cable and TW-1 converter (75 microns amplitude)	101-063-093
HG-152 Spot Welder with 8' cable and TW-2 converter (125 microns amplitude)	101-063-095
TW-1 Converter	101-135-015
TW-2 Converter	101-135-016
TW-3 Converter (33 microns amplitude)	101-135-031

Note: TW-1, TW-2 and TW-3 converters are supplied with a standard flat tip.

Model GK-5	
GK-5 Spot Welder with 12' cable, 402 converter, and step stud to mount horn (does not include horn and tip)	101-063-168
GK-5 Spot Welder with 12' cable only	101-136-006
Model 402 converter	101-135-014
½" dia. Tapped Horn (includes ½-20 stud)	600-044-020
Step Stud (to adapt horns normally using ⅜-24 stud)	100-098-249

ACCESSORIES

Spot Welding Tips

Code Letter	Material Thickness Inch	Inch	mm	Branson EDP#	Horn Size
A	1/32	0.031	0.793	101-148-050	1/2"
B	3/64	0.047	1.190	101-148-051	1/2"
C	1/16	0.062	1.587	101-148-052	1/2"
D	5/64	0.078	1.984	101-148-053	1/2"
E	3/32	0.093	2.381	101-148-054	1/2"
F	7/64	0.109	2.778	101-148-055	1/2"
G	1/8	0.125	3.175	101-148-056 *	3/4"
H	5/32	0.156	3.969	101-148-057 *	3/4"
I	3/16	0.187	4.762	101-148-058 *	3/4"
J	7/32	0.218	5.556	101-148-059 *	3/4"
K	1/4	0.250	6.350	101-148-060 *	1"
L	9/32	0.281	7.143	101-148-061 *	1"

Spot Welding Kit Consisting of Tips A – J 101-063-028 *

*Use with GK-5 only.

Staking Tips

Code Letter	Profile	Stud Specifications Diameter Inch	Diameter mm	Length Inch	Length mm	Branson EDP#
A	Standard	1/32	.793	.050	1.27	101-148-034
B	Standard	1/16	1.587	.100	2.54	101-148-035
C	Standard	3/32	2.381	.150	3.81	101-148-036
D	Standard	1/8	3.175	.200	5.08	101-148-037
E	Standard	5/32	3.969	.250	6.35	101-148-038
F	Standard	3/16	4.762	.300	7.62	101-148-039
G	Low	1/32	.793	.019	0.49	101-148-040
H	Low	1/16	1.587	.038	0.97	101-148-041
I	Low	3/32	2.381	.056	1.42	101-148-042
J	Low	1/8	3.175	.075	1.91	101-148-043
K	Low	5/32	3.969	.094	2.34	101-148-044
L	Low	3/16	4.762	.112	2.85	101-148-045

Knurled Tips

Profile	Diameter Inch	mm	Branson EDP#
Male Fine	½ inch	12.7	101-148-081
Male Medium	½ inch	12.7	101-148-082
Male Coarse	½ inch	12.7	101-148-083
Female Fine	½ inch	12.7	101-148-084
Female Medium	½ inch	12.7	101-148-085
Female Coarse	½ inch	12.7	101-148-086

Note: See Horn Catalog for complete information on special horns and tips.

Note: All specifications subject to change without notice.

BRANSON SONIC POWER COMPANY

Eagle Rd., Danbury, CT 06810-1961 (203) 796-0400